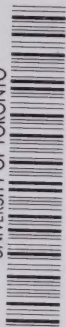


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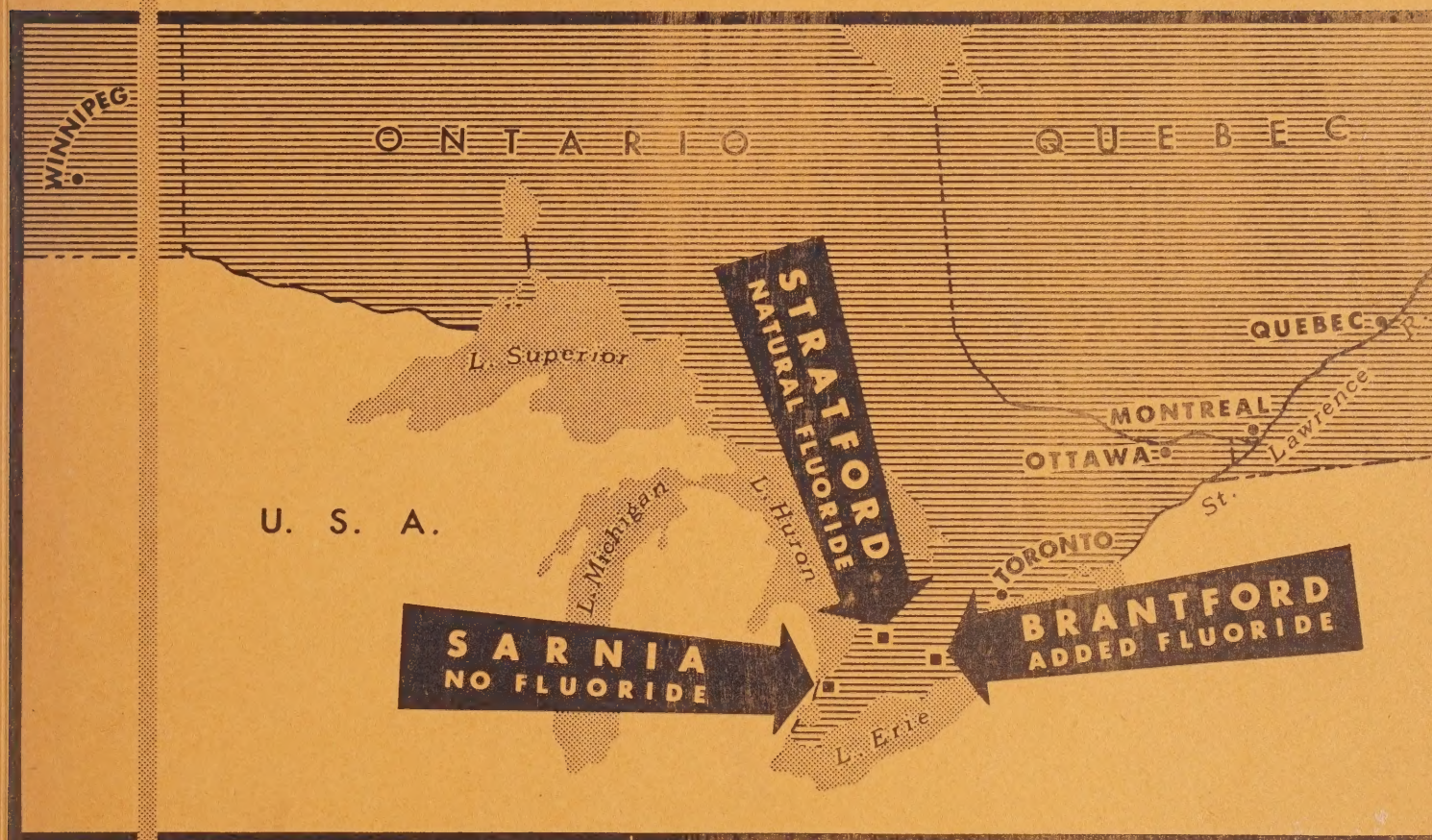
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Fluoridation



1955 REPORT

Canada. Dept of National Health and Welfare.
" Dental Health Division

AAX 1358

MASS CONTROL OF DENTAL CARIES BY FLUORIDATION

OF A PUBLIC WATER SUPPLY

DENTAL EFFECTS OF WATER FLUORIDATION

Fifth Report

on

The Brantford Fluoridation Caries Study

This report is designed to present an analysis and a comparison of the caries data from the first survey (1948), and the latest survey, 1955.

The data from all the surveys to date are shown as an appendix to this report.

Published by the authority of the Hon. Paul Martin
Minister of National Health and Welfare

Dental Health Division
Department of National Health and Welfare

Ottawa

November 1955

REPORT OF THE COMMISSIONER OF THE BUREAU OF LANDS

ON A TRAIL IN THE MOUNTAINS

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PREFACE

On June 20th, 1955, Brantford completed ten years of experience with mechanically fluoridated water.

Earlier reports (I) have shown that the full decay-preventing effect of the fluoridated water on the permanent dentition of the Brantford children began to show itself in 1951, when the first permanent molars appeared in the mouths of the children born there in 1945. In 1953, after these teeth had been exposed in the mouths of the eight-year-old children for a period of two years our reports showed that they were found to be as decay-resistant as those of the children in the corresponding age group in Stratford, where water fluoridated to the extent of 1.6 parts per million from an underground deposit of fluoride had been in use continuously for thirty-eight years. This was the first clear demonstration that mechanically fluoridated water was as effective as naturally fluoridated water in the prevention of tooth decay. It was further confirmed by the 1954 survey. The 1955 survey, which is reported here, contributes additional data which are presented and analyzed in the succeeding pages.

It is intended to continue the study at Brantford and the two control cities, with a view to observing developments in relation to all of the permanent teeth of the children born in Brantford subsequent to June 1945.

This report has been prepared by H.K. Brown, D.D.S., D.D.P.H., Dental Consultant, Department of National Health and Welfare, with the assistance of H.R. McLaren, D.D.S., D.D.P.H., Dental Health Division, G.H. Josie, M.Sc., (Statistician) and Barbara J. Stewart, B.A. (Statistician) of the Research and Statistics Division of the Department of National Health and Welfare. It deals with the changes in caries prevalence which have taken place in the native school-age children of Brantford between January-February 1948, when the first Department of National Health and Welfare survey was made, and January-February 1955, when the Department made its latest survey. The prevalence figures for the intermediate surveys are shown in the appendix, or may be obtained from earlier reports (I), if desired.

H.K. Brown,
Dental Consultant

PRELIMINARY

On June 20th, 1955, Bradford completed ten years of experience with mechanically fluorinated water.

Earlier reports (1) have shown that the 100-day preventing effect of the fluorinated water on the permanent dentition of the Bradford children began to show itself in 1951, when the first permanent molars appeared in the mouths of the children born there in 1945. In 1955, after four years had been elapsed in the mouths of the eight-year-old children for a period of two years our reports showed that they were found to be as decay-resistant as those of the children in the corresponding age group in Bradford, where water fluoridated to the extent of 1.0 parts per million from an underground source of fluoride had been in use continuously for thirty-eight years. This was the first clear demonstration that mechanically fluorinated water was as effective as naturally fluorinated water in the prevention of tooth decay. It was further confirmed in the 1955 survey.

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This report has been prepared by R.E. Brown, D.D.S., D.D.F.H., Dental Consultant, Department of National Health and Welfare, with the assistance of W.A. Wilson, D.D.S., D.D.F.H.; Isabel MacLean, D.D.S., D.D.F.H.; (Dental Surgeon) and Barbara J. Brown, B.S. (Dental Assistant) of the Research and Health Services Division of the Department of National Health and Welfare. It deals with the changes in caries prevalence which have taken place in the native school-age children of Bradford between January-February 1948, when the first Department of National Health and Welfare survey was made, and January-February 1955, when the Department made its latest survey. The prevalence figures for the intermediate surveys are shown in the appendix, any be obtained from earlier reports (1), if desired.

R.E. Brown,
Dental Consultant

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BRANTFORD FLUORIDATION CRIES STUDY

PURPOSE OF THE STUDY

Before the Brantford water supply was fluoridated a great deal of information had been assembled from various parts of the world, which showed beyond any reasonable doubt that water containing 1 to 1.5 parts per million of fluoride, dissolved out from underground deposits, could be consumed safely, and would greatly reduce the incidence of tooth decay, particularly among those consuming it from birth (2). Questions were raised in some quarters as to whether or not the caries inhibiting effect might depend upon other chemical substances with which the fluoride could be associated. There was no evidence from the field of chemistry to suggest this. It appeared to be highly probable that the fluoride itself was entirely responsible for the reduction in tooth decay. It is a common constituent of the earth's crust, readily available, and not costly. This situation gave rise to hope for a simple inexpensive way to prevent tooth decay, especially among children. As it was well known that such trace quantities as 1 part per million in a water supply could be safely consumed, it was decided to find out whether or not the raising of the fluoride content of a previously fluoride-deficient water supply to 1 part per million by the mechanical addition of sodium fluoride would reduce the incidence of tooth decay as effectively as 1 part per million of fluoride derived by the passage of water through an underground deposit of fluoride.

HISTORY OF THE STUDY

Brantford began to fluoridate its water supply in June 1945, and has done so continuously since that time. It is now, in 1955, one of three cities on this continent which have had more than ten years of experience with a community water supply containing about 1 part per million of mechanically added fluoride.

At the time fluoridation began a study was initiated by the Medical Officer of Health of Brant County, Dr. W.L. Hutton, with the help of Dr. Bradley Linscott, the Brantford School Dental Officer, and Mr. Don Williams, the Water Works Engineer (3). By 1946 it was decided that a study should be instituted in which the caries prevalence of Brantford children might be compared periodically with that of a city having a naturally fluoridated water supply, and also with that of a city having no fluoride in its water supply. As this required more extensive facilities than were available to the Brant County Health Unit, the Department of National Health and Welfare was invited to undertake the task. The invitation was accepted. Planning

and organization of the study was done by the Research and Statistics Division and the Dental Health Division of the Department of National Health and Welfare. Sarnia the fluoride content of whose water negligible, and Stratford, whose water supply had contained 1.6 parts per million of fluoride continuously since 1917, agreed to serve as controls. These two cities were known to be comparable to Brantford except for the fluoride content of their water supplies.

The first survey was made in 1948, and subsequent surveys in 1951, 1953, 1954 and 1955. In this report the 1948 data have been analyzed in comparison with those of 1955, with a view to showing the change in caries prevalence which has occurred during the seven-year period of 1948-55. Analysis of the data obtained in all the surveys is given in the appendix.

SELECTION OF CHILDREN FOR EXAMINATION

Within the age groups 6-8, 9-11 and 12-14 years, the total of children in each city who are eligible for inclusion in the study is determined on the basis of 'continuous' residence, where 'continuous' residence is defined as including absences, since birth, of six weeks or less. Thus the study compares a group of children (Brantford) who have used a mechanically fluoridated water supply continuously since June 1945, and who before that date did not use fluoridated water, with a group (Sarnia) who continuously since birth have not used fluoridated water, and a second group (Stratford) who have used continuously since birth water fluoridated from underground deposits of fluoride. For the individual children, residence eligibility is determined from information supplied by the parents. All schools of each city are canvassed, secondary as well as primary.

On the basis of data concerning the ordinary incidence of dental caries, it was decided to examine at least 500 children in each age group in each city. Where the number of eligible children is excessively greater than this total, the number is reduced by a random (systematic) sampling procedure in the manner described in "A Suggested Methodology for Fluoridation Surveys in Canada" (4). In Brantford, sampling has been performed in all surveys and for all age groups; in Sarnia and Stratford, sampling has been initiated in the younger age groups in the more recent surveys. Table 1, page 3, shows for each city in 1948 and 1955 the totals of eligible children, the totals of those chosen for examination, and the number actually examined.

TABLE 1

TOTAL CHILDREN ELIGIBLE AND TOTAL EXAMINED, BY AGE GROUP
Brantford, Sarnia and Stratford, 1948 and 1955

<u>1948</u>	<u>Age Group</u>	<u>Sarnia</u>	<u>Brantford</u>	<u>Stratford</u>
Total Eligible	6-8	677	963	511
No. Chosen for Exam.		*	624	*
No. Examined		669	619	505
Total Eligible	9-11	580	816	434
No. Chosen for Exam.		*	602	*
No. Examined		571	595	432
Total Eligible	12-14	495	747	376
No. Chosen for Exam.		*	600	*
No. Examined		486	593	371
<u>1955</u>				
Total Eligible	6-8	815	1,321	767
No. Chosen for Exam.		576	528	548
No. Examined		571	508	541
Total Eligible	9-11	581	846	494
No. Chosen for Exam.		*	529	*
No. Examined		573	522	485
Total Eligible	12-14	500	769	438
No. Chosen for Exam.		*	538	*
No. Examined		485	523	434

* No sampling performed.

Census population, 1951: Brantford, 36,727; Sarnia, 34,697; Stratford, 18,785. Sarnia survey area includes Point Edward which is served by the Sarnia water supply, but not other outlying areas annexed in 1953.

METHOD OF EXAMINING AND RECORDING

With a view to maintaining as uniform a scale of observation as possible throughout the study, all examinations have been done by the same examiner, using a portable examining light of specific intensity kept at a constant distance, plane mouth mirrors and No. 5 Clev-dent explorers. The lowest limit in size for a caries lesion was defined as one in which the point of the explorer would stick and resist direct withdrawal, or in which softness could be felt. Hard discolored enamel surfaces and enamel imperfections were not recorded as caries. Any observable mottling was recorded. Oral hygiene was also recorded and classified as 'good', 'fair', 'poor'.

A chart depicting all the coronal surfaces of both permanent and primary teeth was used for recording. Although this report presents data only for DMF (decayed, missing and filled) permanent teeth and df (decayed and filled) primary teeth, tooth decay was recorded in the detail necessary for analysis by the number of surfaces affected. In addition every tooth space was accounted for in order that later analysis might be made in terms of a DMF tooth record of all erupted teeth per child.

FINDINGS

This report is devoted chiefly to presenting the data showing the extent of change in caries-prevalence which has taken place in Brantford between 1948, when the Department of National Health and Welfare did its first survey, and 1955. Data for the intervening survey years 1951, 1953, and 1954 are shown in the appendix of this report.

The Stratford data are presented, as in previous reports, for the purpose of showing the degree of caries reduction which the Brantford children might be expected to attain, after sufficient time had elapsed for those born since the inception of fluoridation (June 1945) to produce a full set of permanent teeth. This requires about 12 years from time of birth. As yet only the permanent teeth of the Brantford 6-8 age group may be compared with those of the corresponding Stratford age group with any reasonable expectations of finding an equal degree of caries resistance.

In the sections following, data from the 1948 and the 1955 surveys are presented in respect to (1) all permanent teeth, (2) first permanent (six-year) molars, (3) permanent upper incisors and (4) primary teeth. Statistics are given separately for the first permanent molars since these are the permanent teeth which first reach the stage of having been fully calcified during the period of fluoridation,

and also for the reason that they are the most caries-vulnerable tooth of the permanent dentition. In the case of the upper permanent incisors, which demonstrate more dramatically than any other teeth the caries-preventing effect of fluoride, the opportunity is afforded too of observing the topical effect on enamel which had been wholly or partially calcified before the initiation of fluoridation. Except for permanent upper incisors and primary teeth, data are presented for each of the three age groups, 6-8, 9-11, 12-14, which were chosen because of their relation to the permanent tooth eruption pattern.

The indices used here to measure the extent of caries are (a) percentage of children having caries-free teeth, (b) tooth mortality rate (calculated only for all permanent teeth), and (c) mean DMF permanent teeth (for primary, mean df teeth). These indices are presented in turn for each type of tooth mentioned above. Standard errors are shown in the appendix, in relation to all surveys conducted during the course of the study to date.

In Brantford during the total study period the caries-prevalence trend has been dramatically downward in all age groups studied, with some variations in the downward rate. As a generalization it may be said that the data show that in the fluoride-free control city of Sarnia the caries prevalence has fluctuated at a high level from survey to survey, while in the naturally fluoridated control city of Stratford it has fluctuated at a low level.

Percentage of Children Having Caries-Free Permanent Teeth

One measure of the effectiveness of fluoridation as a caries-preventive procedure may be obtained from examination of the numbers of children in Sarnia, Brantford and Stratford, having caries-free permanent teeth in 1948 and 1955. Table 2 (p. 6), and Fig. II (p. 10), summarize the findings in this regard, expressed as percentages.

In 1948 the percentages of children in Brantford and Sarnia who were caries-free differed but little. In comparison with Stratford children, however, significantly lower percentages of caries-free children were found in Brantford, at all ages studied. This was to be expected; Stratford children had used fluoridated water continuously since birth, while even the youngest of the children in the Brantford study-group were two and a half years of age at the time fluoridation of that city's water supply was instituted.

By 1955 substantial increases had occurred in the percentages of caries-free children in Brantford, at all ages studied.

In both Sarnia and Stratford, on the other hand, the percentages of caries-free children in 1955 remained at somewhat below the 1948 levels. Consequently, the Sarnia-Brantford differences in percentages of caries-free children had increased significantly, in favour of Brantford children at all ages. No significant differences were found in 1955 between the percentages of caries-free children aged 6-8 years in Brantford and Stratford. In the two older age-groups, in 1955, there continued to be differences in favour of Stratford children, as could be expected. However, these were considerably smaller than in 1948, which was also to be expected.

TABLE 2

PERCENTAGE OF CHILDREN HAVING CARIES-FREE PERMANENT TEETH

		Percentage of Children Having Caries-Free Permanent Teeth		
Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	40.96	46.69	78.42
	1955	32.75	66.14	68.21
9-11	1948	6.13	5.71	52.08
	1955	4.19	25.48	32.99
12-14	1948	0.62	1.18	27.22
	1955	1.86	6.69	20.28

Tooth Mortality

Tooth mortality among children in Sarnia, Brantford and Stratford, in 1948 and in 1955, is shown in Table 3, page 7. The findings are expressed in terms of the numbers, per 100 children of permanent teeth extracted and/or indicated for extraction. (A tooth which is too badly broken down and infected to be saved by ordinary treatment is classified, for the purposes of these surveys, as indicated for extraction.)

In 1948 tooth mortality among Brantford children was significantly lower than it was among Sarnia children, at all ages studied. No significant difference existed between tooth mortality of Brantford and Stratford children, aged 6-8 years; among Brantford children aged 9-11 years, and 12-14 years, however, tooth mortality was significantly higher than among Stratford children of the same ages.

There is a correlation between tooth mortality and caries prevalence in terms of the number of teeth attacked, unless the course of caries is halted by treatment.

In 1948, after three years' exposure to fluoridated water, the prevalence of dental caries among Brantford and Sarnia children was still of the same order. However, tooth mortality among Brantford children was considerably less than among Sarnia children. This could be accounted for by the fact that, in the former community, a much more favourable ratio existed between treated and untreated carious defects than was observed among Sarnia children. The prevalence of dental caries among Brantford children, in 1948, was approximately four times greater than that of Stratford children; comparison of tooth mortality rates among Brantford and Stratford children showed Brantford children to have four times the tooth-loss experienced by Stratford children.

By 1955, tooth mortality rates among Brantford children continued to be significantly lower than those of Sarnia children, age for age. In Sarnia, no significant changes had occurred in the tooth mortality of children aged 6-8 and 9-11 years, during the period 1948-55, while significant reduction was observed among children aged 12-14 years. During the same period, among Brantford children, a slight (non-significant) decrease took place in the 6-8 year group, and markedly significant decreases in tooth mortality had occurred in the two older age groups, which were concomitant with the reduction in dental caries prevalence that occurred among Brantford children from 1948 to 1955. Comparison of tooth mortality among Brantford and Stratford children, in 1955, showed no significant differences among children aged 6-8 and 9-11 years; however, while the gap between tooth mortality of 12-14 year-old children had narrowed considerably, tooth-loss was still significantly greater among Brantford children in this age group.

TABLE 3

MEAN TOOTH MORTALITY (MISSING AND IRREPARABLE) PERMANENT
TEETH PER 100 CHILDREN

		Mean Tooth Mortality (Missing and Irreparable Permanent Teeth) Per 100 Children		
Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	7.03	1.62	0.99
	1955	4.20	1.38	3.51
9-11	1948	51.31	28.91	5.09
	1955	41.54	8.24	8.66
12-14	1948	137.24	84.32	18.87
	1955	105.77	41.49	25.81

Mean DMF Permanent Teeth

The dental caries experience of children in Sarnia, Brantford and Stratford in 1948 and in 1955 is shown in Table 4, and Fig. I (p. 9). The data are expressed in terms of the mean numbers of decayed, missing and filled permanent teeth per child.

Between 1948 and 1955, a marked and statistically significant reduction occurred in the prevalence of dental caries among Brantford children, at all ages under study. In Sarnia (the non-fluoride control city), however, the prevalence of dental caries in 1955 was slightly higher but on the same order as was found in 1948. Stratford children also exhibited a slightly higher prevalence of dental caries in 1955, over the 1948 levels.

The Brantford-Sarnia differences in caries prevalence in 1948 were somewhat in favour of Brantford children, but were, in the main, non-significant. By 1955 the differences had increased significantly in favour of the Brantford children at all ages studied. Between children aged 6-8 years in Brantford and Stratford, as was the case in 1954, no significant differences in DMF rates were observed in 1955. In the case of children aged 9-11 years, and 12-14 years, the Brantford-Stratford differences in caries prevalence remained in favour of the Stratford children, as was the case in 1948. However, although these differences continued to be significant, they were considerably smaller than in 1948.

TABLE 4

MEAN DMF (DECAYED, MISSING, FILLED) PERMANENT TEETH PER CHILD

Mean DMF Permanent Teeth Per Child				
Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	1.60	1.41	0.41
	1955	1.88	0.69	0.67
9-11	1948	4.21	4.07	1.13
	1955	4.44	2.28	1.89
12-14	1948	7.94	7.68	2.55
	1955	8.42	4.84	3.77

FIG. I
DMF PERMANENT TEETH PER CHILD
 SARNIA, BRANTFORD & STRATFORD 1948-1955

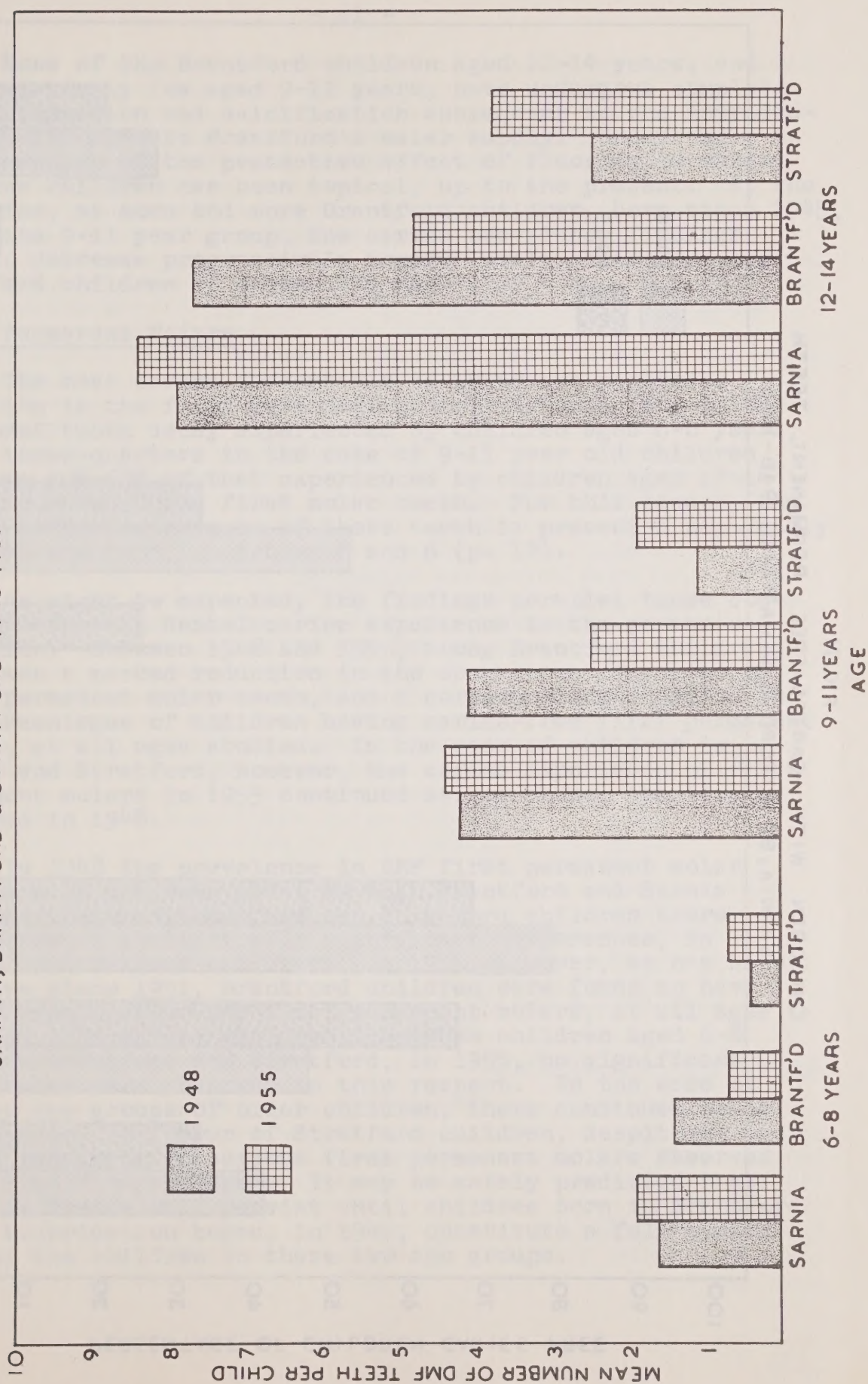
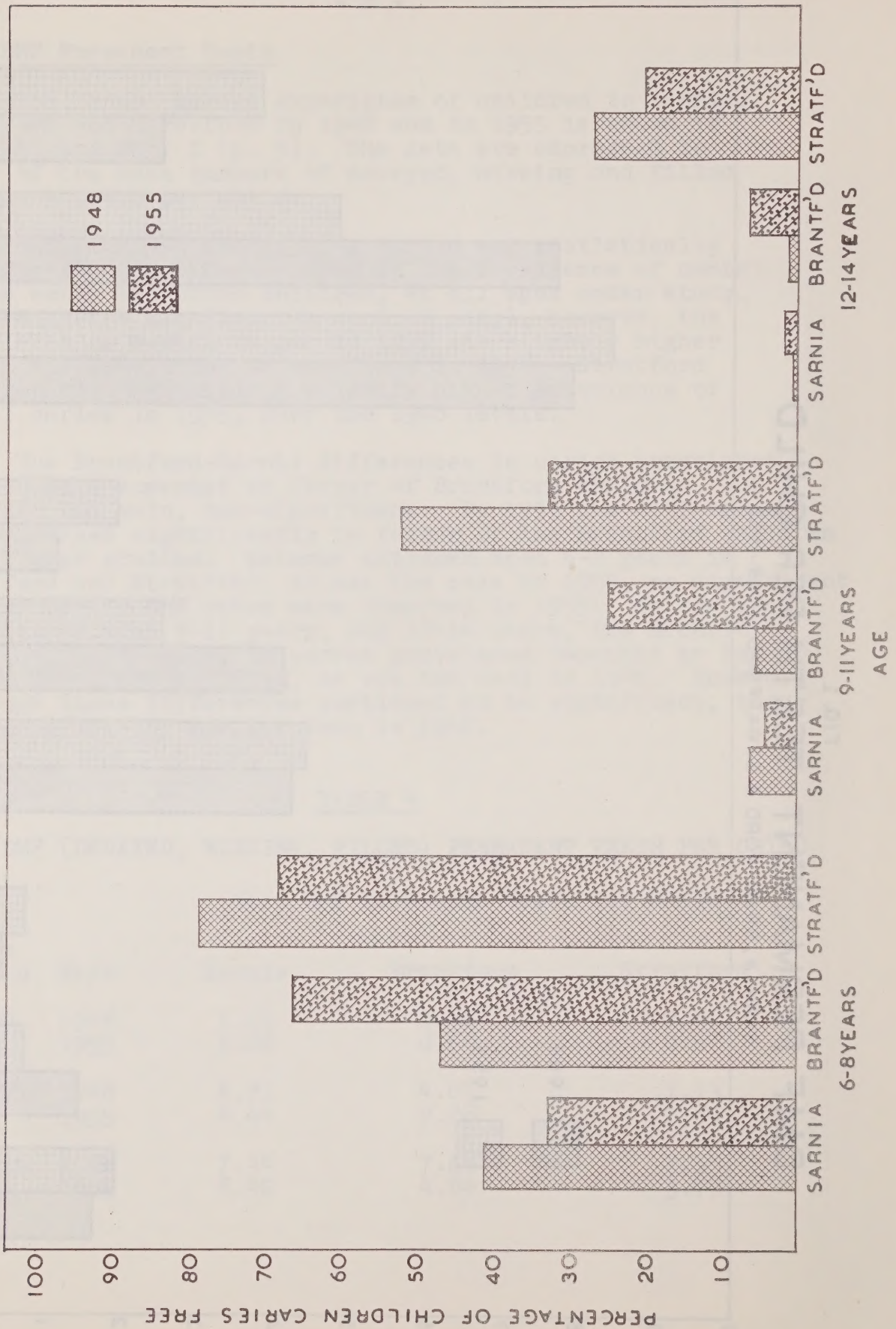


FIG. II
CHILDREN WITH CARIES-FREE PERMANENT TEETH
SARNIA, BRANTFORD & STRATFORD, 1948-1955



None of the Brantford children aged 12-14 years, and only relatively few aged 9-11 years, have undergone complete enamel formation and calcification subsequent to the introduction of fluoride to Brantford's water supply. Undoubtedly a large measure of the protective effect of fluoridated water in these children has been topical, up to the present. At the same time, as more and more Brantford children, born since 1945, enter the 9-11 year group, the caries prevalence findings tend to decrease progressively toward levels observed among Stratford children of comparable age.

First Permanent Molars

The most caries-susceptible tooth of the permanent dentition is the first permanent molar; virtually all of the permanent tooth decay experienced by children aged 6-8 years, about three-quarters in the case of 9-11 year old children and from 50%-60% of that experienced by children aged 12-14 years, occurs in the first molar teeth. For this reason, the dental caries experience of these teeth is presented separately for 1948 and 1955, in Tables 5 and 6 (p. 12).

As might be expected, the findings parallel those concerning over-all dental caries experience in the permanent dentition. Between 1948 and 1955, among Brantford children, there was a marked reduction in the occurrence of caries in first permanent molar teeth, and a corresponding increase in the percentages of children having caries-free first permanent molars, at all ages studied. In the case of children in Sarnia and Stratford, however, the caries experience of first permanent molars in 1955 continued at, or above, the levels observed in 1948.

In 1948 the prevalence in DMF first permanent molar teeth was of the same order in both Brantford and Sarnia children; between Brantford and Stratford children there were observed statistically significant differences, in favour of Stratford children. In 1955, however, as has been the case since 1951, Brantford children were found to have significantly fewer DMF first permanent molars, at all ages studied, than Sarnia children. Between children aged 6-8 years in Brantford and Stratford, in 1955, no significant differences were observed in this respect. In the case of the two age groups of older children, there continued to be differences, in favour of Stratford children, despite a marked reduction in carious first permanent molars observed among Brantford children. It may be safely predicted that this difference will persist until children born in Brantford since fluoridation began, in 1945, constitute a full complement of the children in these two age groups.

TABLE 5

PERCENTAGE OF CHILDREN HAVING CARIES-FREE
FIRST PERMANENT MOLARS

Percentage of Children Having Caries-Free
First Permanent Molars

Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	41.26	46.85	78.42
	1955	32.57	67.13	68.39
9-11	1948	6.65	6.22	52.31
	1955	3.49	26.25	33.61
12-14	1948	1.03	2.02	33.69
	1955	2.06	8.80	23.27

TABLE 6

MEAN DMF (DECAYED, MISSING, FILLED) FIRST PERMANENT
MOLARS PER CHILD

Mean DMF First Permanent Molars Per Child

Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	1.55	1.39	0.41
	1955	1.82	0.67	0.67
9-11	1948	3.15	3.26	1.07
	1955	3.35	2.04	1.70
12-14	1948	3.62	3.65	1.76
	1955	3.69	3.04	2.21

Upper Permanent Incisors

The caries inhibiting effect of fluoridated water became apparent to a measurable degree in the upper permanent incisor teeth in Brantford much earlier than in any of the other teeth, either permanent or deciduous. As early as January 1948, i.e., about two and one-half years after fluoridation began there were significantly fewer carious upper incisors in the Brantford 9-11 year group than in the corresponding group in Sarnia. A small, non-significant lower

prevalence was also shown by the 12-14 year group in that year. In all succeeding surveys, including that of 1955 a highly significant difference in favour of Brantford over Sarnia, was shown in both the 9-11 and 12-14 year age-groups. The increased caries resistance of the 12-14 year group from the 1948 to the 1954 survey can be accounted for only by the effect of the fluoride upon completely calcified enamel, either before or after eruption, or both. Even at the time of the 1955 survey the greater part of the upper incisor enamel of this age group was presumably calcified before fluoridation was begun in Brantford. These findings, appear to confirm beyond any reason for doubt that water fluoridated to the extent of 1 part per million will inhibit significantly the caries attack rate in enamel already formed before fluoridation began. Presumably this is a topical effect. (See Table 7, p. 13, and Table 8, p. 14).

A marked increase in caries in the upper incisors is shown by the data for both the older age groups in Stratford, and more particularly for the 12-14 year group. The caries lesions occurring in the incisor teeth of the Stratford children are for the most part of a pin-point size even in the 12-14 year group. They are, on the average larger in the Brantford children and much larger in the Sarnia children. While it is probable that an upward fluctuation in the caries attack rate in terms of these small cavities may have occurred in Stratford in 1954 and in 1955, the possibility cannot be discounted that it may have been coupled with an increased intensity of examination, resulting in the scoring of a larger number of pin-point lesions. (The so-called 'pre-carious' classification of such lesions used in certain other studies was not adopted for these surveys.)

TABLE 7

PERCENTAGE OF CHILDREN HAVING CARIES-FREE PERMANENT
UPPER INCISORS

Percentage of Children Having Caries-Free
Permanent Upper Incisors

Age Group	Year	Sarnia	Brantford	Stratford
9-11	1948	76.53	82.86	97.07
	1955	70.68	91.57	95.05
12-14	1948	53.91	56.16	95.69
	1955	44.54	78.20	79.72

TABLE 8

MEAN DMF (DECAYED, MISSING, FILLED) PERMANENT
UPPER INCISORS PER CHILD

		Mean DMF Permanent Upper Incisors Per Child		
Age Group	Year	Sarnia	Brantford	Stratford
9-11	1948	0.56	0.34	0.01
	1955	0.65	0.13	0.07
12-14	1948	1.16	1.05	0.07
	1955	1.28	0.41	0.36

Deciduous Teeth

It is not possible to measure precisely the dental caries experience of deciduous teeth, because of the impossibility of determining at the time of examination, whether a missing deciduous tooth was lost as a direct result of caries attack or because of natural exfoliation. Nevertheless, by measuring the observable caries experience in terms of decayed and filled deciduous teeth, a fairly reliable index of the deciduous tooth caries experience may be obtained. The findings concerning deciduous tooth caries experience of children aged 6-11 years in Sarnia, Brantford and Stratford for the years 1948 and 1955 are presented in Table 9 (p. 15), and Table 10 (p. 15).

In 1948 no significant differences were found in the prevalence of deciduous tooth caries among children in Brantford and Sarnia. Stratford children, however, were found to have significantly fewer decayed and filled (df) deciduous teeth, at all ages, 6-11 years, than Brantford children. By 1955 Brantford children in both the age groups, 6-8 and 9-11 years, were found to have significantly fewer df deciduous teeth than Sarnia children; in comparison with Stratford children, no significant differences were found in children aged 6-8 years in Brantford. In the 9-11 year group, however, Brantford children continued to have significantly higher deciduous tooth caries experience.

The prevalence of deciduous tooth caries in both Sarnia and Stratford children, in 1955, remained relatively unchanged from 1948 levels. Brantford children in 1955, on the other hand were observed to have significantly fewer df deciduous teeth than had children of comparable age in that city, in 1948. Also, there was a significant increase in the percentage of Brantford children aged 6-8 years who were caries-free (deciduous dentition) in 1955, over the 1948 findings, in this regard.

TABLE 9

PERCENTAGE OF CHILDREN HAVING CARIES-FREE DECIDUOUS TEETH

Percentage of Children Having Caries-Free
Deciduous Teeth

Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	10.16	12.28	35.65
	1955	8.58	23.82	30.87
9-11	1948	33.63	34.96	40.97
	1955	36.13	37.93	42.27

TABLE 10

MEAN df (decayed, filled) DECIDUOUS TEETH PER CHILD

Mean df Deciduous Teeth Per Child

Age Group	Year	Sarnia	Brantford	Stratford
6-8	1948	4.89	4.95	2.20
	1955	5.09	2.93	2.60
9-11	1948	2.50	2.37	1.66
	1955	2.31	1.99	1.65

Other Effects of Fluoridation - Mottling

All detectable enamel opacities and discolorations were recorded and classified as to degree of severity. Enamel opacities other than mottling are of fairly frequent occurrence in all communities whether or not fluoride is present in the water. It is very difficult if not impossible to distinguish clinically between certain of these opacities which occur in the absence of fluoride in the water and those which occur in the presence of water-borne fluoride, and are almost certainly fluorosis (5).

A small percentage of the native children of Stratford have mild mottling of the enamel, which in no case is unsightly, and is detectable only by an experienced examiner. The Stratford water supply contains a concentration of fluoride which is sixty percent higher than that used in Brantford and elsewhere for the prevention of tooth decay. A few cases of

mild mottling, barely detectable even on close examination were seen in Brantford. Enamel opacities resembling some of those seen in Brantford and Stratford were also observed in a small number of children in Sarnia. The observations made in both Brantford and Stratford provide ample proof that no significant mottling occurs with fluoride levels up to 1.6 parts per million.

Medical Effects of Water Fluoridation

After ten years of experience with fluoridation in Brantford the Brant County Department of Health reports that no ill-effects have been detected there.

As a further check on the observations of his Department the Medical Officer of Health, Dr. W.L. Hutton, asked the practising physicians of Brantford whether they had observed any untoward effects which might be attributable to fluoride. The following reply was received:

"At a recent meeting of the Medical Staff of the Brantford General Hospital, the members were asked if they had seen any untoward effects from the use of fluoridated water in this vicinity, with the result that no such observations had been made by any practitioner to the best of our knowledge."

Just prior to the publication of this report all of the physicians of Stratford were asked individually whether or not any of them had observed any ill-effects from the fluoride content of the water supply there, (1.6 ppm.), which is sixty per cent higher than that used at Brantford and has been in continuous use for thirty-eight years. All replied that they had not observed any ill-effects.

Discussion

The chief purpose of this 1955 report is to present the caries prevalence picture as it was in Brantford at the end of 10 years of fluoridation, and to show the changes that have occurred during the seven years that have elapsed since the first Department of National Health and Welfare survey in 1948. In addition it is of interest to observe some of the developments which have been brought to light by the data collected during this period. Therefore, tables presenting these data along with those of 1948 and 1955 are shown in the appendix to this report.

The apparent 1955 increase in caries in the 6-8 year age group in both Brantford and Stratford to about the 1953 Brantford level is of interest. The data have shown fluctuations in the caries level from survey to survey in both the control groups. On the other hand no such fluctuations have

occurred in Brantford, until this one affecting the 6-8 year group in 1955. Some of the factors which may contribute to this situation are: (a) small real variations in caries prevalence which are reflected only in the highly caries-vulnerable six year molar and not to a measurable degree in the other permanent teeth; (b) unconscious variations from one survey to another in the intensity of examination, even when only one examiner is used.

The effect of either, or even both, of these factors taken together could have been masked by the progressively caries-inhibiting effect of the fluoride in Brantford until such time as it had exercised its maximum attainable effect. This maximum was attained in the six year molars of the 6-8 year group by 1953, and maintained in 1954. By 1955 either or both of the factors referred to above could have conspired to create the picture presented by the 1954-55 data, which shows a return to the 1953 caries level for this age group, but which is very significantly below that for 1948, and much below the level for Sarnia in 1955. It is noteworthy that the Stratford 6-8 age group shows an almost exactly parallel rise between 1954 and 1955, which suggests that the same factor or factors were operative in both places. There is some suggestion that they were also operative in Sarnia.

The increasing caries resistance of the permanent upper incisor teeth in Brantford from 1948 to 1955 deserves some comment. The major portion of this effect in the 9-11 year group, until 1955, must be presumed to have been due to the effect of fluoride after the enamel had been calcified. Practically all of the incisor enamel of the 12-14 year age group up to and including the 1954 survey was probably calcified before fluoridation began, and even the greater portion of it for that group in 1955. These findings tend to support the theory that the topical effect of fluoride is most marked in the immediate post-eruptive period.

The reduction in the amount of tooth substance destroyed by decay is even more impressive than the decrease in the number of teeth attacked. There is, unfortunately, no reliable method of measuring the volume of tooth structure damaged by the decay process. If this were possible there appears to be little doubt that fluoridation would be found to prevent and inhibit tooth decay to the extent of somewhere in the range of 75% to 80%. If coupled with the practice of brushing the teeth or rinsing the mouth just after eating, and avoiding sticky sweet snacks between meals and before going to bed, it is probable that tooth decay and gum disease could be almost entirely prevented.

As matters now stand, either tooth decay or gum disease (pyorrhea), or both, attack nearly every Canadian at some time during his life. Over 98% of school-age children brought up in communities where there is no fluoride in the water experience tooth decay, which if not treated leads inevitably to abscesses of the jaws, and loss of one or more teeth. From the age of 30 years upwards the almost entirely preventable diseases of the gums attack most Canadians, and from that point on are responsible for as much infection of the mouth as tooth decay. An important factor contributing to gum disease is the early loss or mutilation of the dentition by decay. The care of oral diseases and disabilities has become the most costly single treatment item on the health budget of the average Canadian (6). Canada employs one dentist to every three physicians, and needs one dentist to every two physicians, as in the United States, in order to meet present treatment demands. This situation has arisen not only through the increasing incidence of decay and periodontal disease, but also through the lack of preventive measures suitable for mass use. Fluoridation comes as a much needed and important partial answer. It brings the prevalence of tooth decay down to a point where it can be economically controlled by treatment, and practically eliminated among those who practice good eating habits and good oral hygiene.

SUMMARY

Brantford has had more than 10 years of experience with 1 part per million of fluoride in its water supply. During that time a very important, statistically significant reduction in tooth decay has occurred in all the age groups studied, while in the two control cities of Sarnia and Stratford it has either remained at about the same level or increased somewhat.

The children born in Brantford since fluoridation began now exhibit the same degree of resistance to dental caries as those of the corresponding age group in Stratford, where water containing from an underground deposit about 60% more fluoride than the water used at Brantford, has been consumed during the past thirty-eight years.

No ill-effects of either a medical or a dental nature have been revealed by our study, or reported by the medical profession, by the dental profession, or by the health authorities in either Brantford or Stratford. These findings and corroborating evidence from other contemporary studies (7,8,9) have provided the basis for recent official recommendations by the Canadian Dental Association (10), the Canadian Medical Association (11), and the Canadian Public Health Association (12) that the fluoride concentration of all fluoride-deficient water supplies be raised to 1 part per million by the mechanical addition of fluoride.

A fact of fundamental importance in public health has been established. Raising the fluoride content of a fluoride-deficient water supply to about 1 part per million will lower the attack rate of tooth decay among children born subsequent to fluoridation, to about one third of that which prevails among those born and continuing to reside in communities which have no fluoride in their water supply, such as Sarnia. For every three decayed teeth they would have had, they have only one. Moreover, in this one there is very much less decay and it progresses much more slowly than in the average tooth where there is no fluoride, as these teeth resist and delay the progress of decay. This makes treatment of the residual decay easier for both the patient and the dentist, reduces the need of very young children for extensive dental treatment and aids in preventing the premature loss of teeth. This loss is the chief cause of irregular permanent teeth.

In order that communities now planning fluoridation might have available to them a uniform method of carrying out dental surveys, along with sound statistical procedures for the evaluation of the data, the Dental Health Division and the Research and Statistics Division of the Department of National Health and Welfare, have prepared a methodology which may be had from the former on request (4).

ACKNOWLEDGEMENTS

This study has been greatly facilitated by the courteous cooperation of the school authorities, Public, Separate and High, of Brantford, Sarnia and Stratford. The friendly interest and help from Principals and School Staffs has been reflected in the highest degree of cooperation from the pupils. For this we wish to express our sincere thanks.

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APPENDIX

COMPARATIVE DATA FOR ALL SURVEYS 1948, 1951, 1953, 1954, 1955

TABLE I

TOTAL CHILDREN ELIGIBLE AND TOTAL EXAMINED, BY AGE GROUP
Brantford, Sarnia and Stratford, 1948, 1951, 1953, 1954 and 1955

Year	Brantford (population 1951, 36,727)											
	Total Eligible			No. Chosen for Examination			No. Examined					
	Age			Age			Age			Age		
	6-8	9-11	12-14	Total	6-8	9-11	12-14	Total	6-8	9-11	12-14	Total
1948	963	816	747	2,526	624	602	600	1,826	619	595	593	1,807
1951	1,053	803	756	2,612	607	592	604	1,803	579	578	585	1,742
1953	Not Available				536	551	521	1,608	526	548	518	1,592
1954	1,288	901	776	2,965	512	515	515	1,542	490	502	490	1,482
1955	1,321	846	769	2,936	528	529	538	1,595	508	522	523	1,553
Sarnia* (population 1951, 34,697)												
1948	677	580	495	1,752	-	-**	-	-	669	571	486	1,726
1951	720	634	514	1,868	-	-	-	-	691	619	506	1,816
1953	840	699	553	2,092	-	-	-	-	807	674	539	2,020
1954	847	599	597	2,043	564	-	-	1,760	553	580	547	1,680
1955	815	581	500	1,896	576	-	-	1,657	571	573	485	1,629
Stratford (population 1951, 18,785)												
1948	511	434	376	1,321	-	-**	-	-	505	432	371	1,308
1951	508	471	405	1,384	-	-	-	-	497	456	395	1,348
1954	685	493	390	1,568	-	-	-	-	662	486	383	1,531
1955	767	494	438	1,699	548	-	-	1,480	541	485	434	1,460

* The population of Sarnia has increased rapidly in recent years. According to the 1941 Census the population was 18,734, and by municipal estimate it was 23,841 in 1949. For all five surveys, the children of nearby Point Edward which is served by the Sarnia water system, and which had a population of 1,838 in 1951, were included in the Sarnia survey. However, other outlying areas which were annexed by the city of Sarnia in 1953 were not included in the 1953, 1954 or 1955 surveys.

** Indicates that no sampling took place.

Note: The last two surveys in Stratford were conducted much closer to the end of the year than previously; the November 1953 data for Stratford are therefore termed "1954" in the new comparisons, and those for 1954 termed "1955".

TABLE II

PERCENTAGE OF CHILDREN HAVING CARIES-FREE PERMANENT TEETH

Age Group	Year	Percentage of Children Having Caries-Free Permanent Teeth and Standard Error of Percentage		
		Sarnia	Brantford	Stratford
6-8	1948	40.96 $\pm$ 1.901	46.69 $\pm$ 2.005	78.42 $\pm$ 1.831
	1951	32.71 $\pm$ 1.785	59.24 $\pm$ 2.043	65.19 $\pm$ 2.136
	1953	32.09 $\pm$ 1.644	69.20 $\pm$ 2.013	...
	1954	39.06 $\pm$ 2.075	75.92 $\pm$ 1.932	75.83 $\pm$ 1.664*
	1955	32.75 $\pm$ 1.964	66.14 $\pm$ 2.100	68.21 $\pm$ 2.002**
9-11	1948	6.13 $\pm$ 1.001	5.71 $\pm$ 0.950	52.08 $\pm$ 2.404
	1951	3.55 $\pm$ 0.749	17.13 $\pm$ 1.566	35.75 $\pm$ 2.244
	1953	3.56 $\pm$ 0.718	23.36 $\pm$ 1.809	...
	1954	4.48 $\pm$ 0.859	25.70 $\pm$ 1.950	42.80 $\pm$ 2.244*
	1955	4.19 $\pm$ 0.837	25.48 $\pm$ 1.907	32.99 $\pm$ 2.135**
12-14	1948	0.62 $\pm$ 0.350	1.18 $\pm$ 0.447	27.22 $\pm$ 2.310
	1951	1.19 $\pm$ 0.484	4.27 $\pm$ 0.839	22.03 $\pm$ 2.084
	1953	1.11 $\pm$ 0.449	8.69 $\pm$ 1.238	...
	1954	2.01 $\pm$ 0.600	7.12 $\pm$ 1.164	23.24 $\pm$ 2.158*
	1955	1.86 $\pm$ 0.614	6.69 $\pm$ 1.093	20.28 $\pm$ 1.930**
Differences in Percentage of Children Having Caries-Free Permanent Teeth				
Age Group	Inter-City			Inter-Year
	Year	Sarnia-Brantford	Brantford-Stratford	Years Sarnia Brantford Stratford
6-8	1948	5.73 S	31.73 SS	1948-51 -8.25 SS 12.55 SS -13.23 SS
	1951	26.53 SS	5.95 S	1951-53 -0.62 NS 9.96 SS) 10.64 SS
	1953	37.11 SS	...	1953-54 6.97 S 6.72 S)
	1954	36.86 SS	-0.09 NS	1954-55 -6.31 S -9.78 SS -7.62 S
	1955	33.39 S	-2.07 NS	1948-55 -8.21 SS 19.45 NS -10.21 SS
9-11	1948	-0.42 NS	46.37 SS	1948-51 -2.58 S 11.42 SS -16.33 SS
	1951	13.58 SS	18.62 SS	1951-53 0.01 NS 6.23 S) 7.05 S
	1953	19.80 SS	...	1953-54 0.92 NS 2.34 NS)
	1954	21.22 SS	17.10 SS	1954-55 -0.29 NS -0.22 NS -9.81 SS
	1955	21.29 SS	7.51 S	1948-55 -1.94 NS 19.77 SS -19.09 SS
12-14	1948	0.56 NS	26.04 SS	1948-51 0.57 NS 3.09 SS -5.19 NS
	1951	3.08 SS	17.76 SS	1951-53 -0.08 NS 4.42 S) 1.21 NS
	1953	3.58 SS	...	1953-54 0.90 NS -5.55 NS)
	1954	5.13 SS	16.10 SS	1954-55 -0.15 NS -0.45 NS -2.96 NS
	1955	4.83 SS	13.59 SS	1948-55 1.24 NS 5.51 SS -6.94 S

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE III

MEAN TOOTH MORTALITY (MISSING AND IRREPARABLE) PERMANENT TEETH
PER 100 CHILDREN

Age Group	Year	Mean Tooth Mortality (Missing and Irreparable Permanent Teeth) Per 100 Children and Standard Error of Mean					
		Sarnia	Brantford	Stratford			
6-8	1948	7.03 $\pm$ 1.367	1.62 $\pm$ 0.641	0.99 $\pm$ 0.441			
	1951	10.42 $\pm$ 1.682	1.21 $\pm$ 0.516	1.41 $\pm$ 0.602			
	1953	8.05 $\pm$ 1.455	2.09 $\pm$ 0.731	... ..			
	1954	5.97 $\pm$ 1.480	1.43 $\pm$ 0.674	1.66 $\pm$ 1.839*			
	1955	4.20 $\pm$ 1.037	1.38 $\pm$ 0.761	3.51 $\pm$ 1.111**			
9-11	1948	51.31 $\pm$ 4.348	28.91 $\pm$ 3.016	5.09 $\pm$ 1.445			
	1951	52.02 $\pm$ 3.953	23.01 $\pm$ 2.522	4.82 $\pm$ 1.367			
	1953	47.33 $\pm$ 4.097	14.23 $\pm$ 2.059	... ..			
	1954	49.83 $\pm$ 3.973	13.94 $\pm$ 2.291	8.02 $\pm$ 1.510*			
	1955	41.54 $\pm$ 3.795	8.24 $\pm$ 1.621	8.66 $\pm$ 1.651**			
12-14	1948	137.24 $\pm$ 7.985	84.32 $\pm$ 5.602	18.87 $\pm$ 2.911			
	1951	125.30 $\pm$ 8.473	62.56 $\pm$ 4.592	20.76 $\pm$ 3.496			
	1953	132.10 $\pm$ 8.820	47.30 $\pm$ 4.667	... ..			
	1954	110.60 $\pm$ 7.221	44.49 $\pm$ 3.963	22.72 $\pm$ 3.553*			
	1955	105.77 $\pm$ 8.114	41.49 $\pm$ 3.988	25.81 $\pm$ 4.276**			
Differences in Mean Tooth Mortality (Missing and Irreparable Permanent Teeth) Per 100 Children							
Age Group	Year	Inter-City		Inter-Year			
		Sarnia- Brantford	Brantford- Stratford	Years	Sarnia	Brantford	Stratford
6-8	1948	-5.41 SS	-0.63 NS	1948-51	3.39 NS	-0.41 NS	0.42 NS
	1951	-9.21 SS	0.20 NS	1951-53	-2.37 NS	0.88 NS	} 0.25 NS
	1953	-5.96 SS	...	1953-54	-2.08 NS	-0.66 NS	
	1954	-4.54 S	0.23 NS	1954-55	-1.77 NS	-0.05 NS	1.85 NS
	1955	-2.82 S	2.13 NS	1948-55	-2.83 NS	-0.24 NS	2.52 S
9-11	1948	-22.40 SS	-23.82 SS	1948-51	0.71 NS	-5.90 NS	0.27 NS
	1951	-29.01 SS	-18.19 SS	1951-53	-4.69 NS	-8.78 S	} 3.20 NS
	1953	-33.10 SS	...	1953-54	2.50 NS	-0.29 NS	
	1954	-35.89 SS	-5.92 S	1954-55	-8.29 NS	-5.70 S	0.64 NS
	1955	-33.30 SS	0.42 NS	1948-55	-9.77 NS	-20.67 SS	3.57 NS
12-14	1948	-52.92 SS	-65.45 SS	1948-51	-11.94 NS	-21.76 SS	1.89 NS
	1951	-62.74 SS	-41.80 SS	1951-53	6.80 NS	-15.26 S	} 1.96 NS
	1953	-84.80 SS	...	1953-54	-21.50 NS	-2.81 NS	
	1954	-66.11 SS	-21.77 SS	1954-55	-4.83 NS	-3.00 NS	3.09 NS
	1955	-64.28 SS	-15.68 S	1948-55	-31.47 S	-42.83 SS	6.94 NS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE IV

MEAN DMF (DECAYED, MISSING, FILLED) PERMANENT TEETH PER CHILD

Age Group	Year	Mean DMF Permanent Teeth Per Child and Standard Error of Mean					
		Sarnia		Brantford		Stratford	
6-8	1948	1.60 $\pm$ 0.064	1.41 $\pm$ 0.064	0.41 $\pm$ 0.040			
	1951	1.99 $\pm$ 0.065	0.93 $\pm$ 0.055	0.75 $\pm$ 0.055			
	1953	2.05 $\pm$ 0.062	0.63 $\pm$ 0.049	...	...		
	1954	1.69 $\pm$ 0.073	0.44 $\pm$ 0.042	0.47 $\pm$ 0.039*			
	1955	1.88 $\pm$ 0.072	0.69 $\pm$ 0.052	0.67 $\pm$ 0.051**			
9-11	1948	4.21 $\pm$ 0.114	4.07 $\pm$ 0.093	1.13 $\pm$ 0.072			
	1951	4.48 $\pm$ 0.102	2.85 $\pm$ 0.085	1.76 $\pm$ 0.081			
	1953	4.67 $\pm$ 0.093	2.47 $\pm$ 0.080	...	...		
	1954	4.44 $\pm$ 0.095	2.27 $\pm$ 0.084	1.46 $\pm$ 0.076*			
	1955	4.44 $\pm$ 0.103	2.28 $\pm$ 0.083	1.89 $\pm$ 0.084**			
12-14	1948	7.94 $\pm$ 0.200	7.68 $\pm$ 0.164	2.55 $\pm$ 0.130			
	1951	8.55 $\pm$ 0.187	6.10 $\pm$ 0.144	3.12 $\pm$ 0.144			
	1953	9.54 $\pm$ 0.192	5.51 $\pm$ 0.157	...	...		
	1954	8.84 $\pm$ 0.062	4.89 $\pm$ 0.159	3.02 $\pm$ 0.139*			
	1955	8.42 $\pm$ 0.196	4.84 $\pm$ 0.137	3.77 $\pm$ 0.156**			
Age Group	Differences in Mean DMF Permanent Teeth Per Child						
	Year	Inter-City		Inter-Year			
		Sarnia-Brantford	Brantford-Stratford	Years	Sarnia	Brantford	Stratford
6-8	1948	-0.19 S	-1.00 SS	1948-51	0.39 SS	-0.48 SS	0.34 SS
	1951	-1.06 SS	-0.18 SS	1951-53	0.06 NS	-0.30 SS	} -0.28 SS
	1953	-1.42 SS	...	1953-54	-0.36 SS	-0.19 S	
	1954	-1.25 SS	0.03 NS	1954-55	0.19 NS	0.25 SS	0.20 SS
	1955	-1.19 SS	-0.02 NS	1948-55	0.28 S	-0.72 SS	0.26 SS
9-11	1948	-0.14 NS	-2.94 SS	1948-51	0.27 NS	-1.22 SS	0.63 SS
	1951	-1.63 SS	-1.09 SS	1951-53	0.19 NS	-0.38 SS	} -0.30 S
	1953	-2.20 SS	...	1953-54	-0.23 NS	-0.20 NS	
	1954	-2.17 SS	-0.81 SS	1954-55	0.00 NS	0.01 NS	0.43 SS
	1955	-2.16 SS	-0.39 SS	1948-55	0.23 NS	-1.79 SS	0.76 SS
12-14	1948	-0.26 NS	-5.13 SS	1948-51	0.61 S	-1.58 SS	0.57 SS
	1951	-2.45 SS	-2.98 SS	1951-53	0.99 SS	-0.59 S	} -0.10 NS
	1953	-4.03 SS	...	1953-54	-0.70 SS	-0.62 S	
	1954	-3.95 SS	-1.87 SS	1954-55	-0.42 S	-0.05 NS	0.75 SS
	1955	-3.58 SS	-1.07 SS	1948-55	0.48 NS	-2.84 SS	1.22 SS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE V

PERCENTAGE OF CHILDREN HAVING CARIES-FREE FIRST PERMANENT MOLARS

Age Group	Year	Percentage of Children Having Caries-Free First Permanent Molars and Standard Error of Percentage		
		Sarnia	Brantford	Stratford
6-8	1948	41.26 $\pm$ 1.904	46.85 $\pm$ 2.006	78.42 $\pm$ 1.831
	1951	32.71 $\pm$ 1.785	59.76 $\pm$ 2.038	65.19 $\pm$ 2.136
	1953	32.34 $\pm$ 1.646	70.15 $\pm$ 1.996	...
	1954	38.52 $\pm$ 2.069	76.53 $\pm$ 1.915	75.83 $\pm$ 1.664*
	1955	32.57 $\pm$ 1.961	67.13 $\pm$ 2.084	68.39 $\pm$ 1.999**
9-11	1948	6.65 $\pm$ 1.046	6.22 $\pm$ 0.989	52.31 $\pm$ 2.403
	1951	4.20 $\pm$ 0.806	17.82 $\pm$ 1.591	36.40 $\pm$ 2.253
	1953	2.97 $\pm$ 0.657	23.36 $\pm$ 1.809	...
	1954	4.66 $\pm$ 0.875	26.69 $\pm$ 1.974	44.24 $\pm$ 2.251*
	1955	3.49 $\pm$ 0.767	26.25 $\pm$ 1.926	33.61 $\pm$ 2.145**
12-14	1948	1.03 $\pm$ 0.451	2.02 $\pm$ 0.575	33.69 $\pm$ 2.454
	1951	3.36 $\pm$ 0.806	4.79 $\pm$ 0.884	26.33 $\pm$ 2.215
	1953	1.67 $\pm$ 0.557	9.46 $\pm$ 1.288	...
	1954	3.11 $\pm$ 0.742	8.78 $\pm$ 1.278	28.98 $\pm$ 2.318*
	1955	2.06 $\pm$ 0.645	8.80 $\pm$ 1.239	23.27 $\pm$ 2.028**
Differences in Percentage of Children Having Caries-Free First Permanent Molars				
Age Group	Inter-City			Inter-Year
	Year	Sarnia-Brantford	Brantford-Stratford	Years
6-8	1948	5.59 S	31.57 SS	1948-51
	1951	27.05 SS	5.43 NS	1951-53
	1953	37.81 SS	...	1953-54
	1954	38.01 SS	-0.70 NS	1954-55
	1955	34.56 SS	1.26 NS	1948-55
9-11	1948	-0.43 NS	46.09 SS	1948-51
	1951	13.62 SS	18.58 SS	1951-53
	1953	20.39 SS	...	1953-54
	1954	22.03 SS	17.55 SS	1954-55
	1955	22.76 SS	7.36 S	1948-55
12-14	1948	0.99 NS	31.67 SS	1948-51
	1951	1.43 NS	21.54 SS	1951-53
	1953	7.79 SS	...	1953-54
	1954	5.67 SS	20.20 SS	1954-55
	1955	6.74 SS	14.47 SS	1948-55

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE VI

MEAN DMF (DECAYED, MISSING, FILLED) FIRST PERMANENT MOLARS PER CHILD

Age Group	Year	Mean DMF First Permanent Molars Per Child and Standard Error of Mean		
		Sarnia	Brantford	Stratford
6-8	1948	1.55 $\pm$ 0.061	1.39 $\pm$ 0.063	0.41 $\pm$ 0.040
	1951	1.96 $\pm$ 0.063	0.92 $\pm$ 0.055	0.75 $\pm$ 0.055
	1953	1.99 $\pm$ 0.058	0.61 $\pm$ 0.048	... ..
	1954	1.66 $\pm$ 0.068	0.43 $\pm$ 0.041	0.47 $\pm$ 0.038*
	1955	1.82 $\pm$ 0.067	0.67 $\pm$ 0.050	0.67 $\pm$ 0.051**
9-11	1948	3.15 $\pm$ 0.051	3.26 $\pm$ 0.048	1.07 $\pm$ 0.065
	1951	3.43 $\pm$ 0.043	2.52 $\pm$ 0.064	1.62 $\pm$ 0.072
	1953	3.56 $\pm$ 0.037	2.26 $\pm$ 0.067	... ..
	1954	3.38 $\pm$ 0.047	2.02 $\pm$ 0.070	1.31 $\pm$ 0.067*
	1955	3.35 $\pm$ 0.046	2.04 $\pm$ 0.069	1.70 $\pm$ 0.070**
12-14	1948	3.62 $\pm$ 0.036	3.65 $\pm$ 0.033	1.76 $\pm$ 0.082
	1951	3.63 $\pm$ 0.040	3.42 $\pm$ 0.045	1.99 $\pm$ 0.080
	1953	3.76 $\pm$ 0.030	3.15 $\pm$ 0.057	... ..
	1954	3.66 $\pm$ 0.038	3.04 $\pm$ 0.060	1.88 $\pm$ 0.079*
	1955	3.69 $\pm$ 0.037	3.04 $\pm$ 0.058	2.21 $\pm$ 0.074**
Differences in Mean DMF First Permanent Molars Per Child				
Age Group	Inter-City			Inter-Year
	Year	Sarnia-Brantford	Brantford-Stratford	Years Sarnia Brantford Stratford
6-8	1948	-0.16 NS	-0.98 SS	1948-51 0.41 SS -0.47 SS 0.34 SS
	1951	-1.04 SS	-0.17 S	1951-53 0.03 NS -0.31 SS } -0.28 SS
	1953	-1.38 SS	...	1953-54 -0.33 SS -0.18 S
	1954	-1.23 SS	0.04 NS	1954-55 0.16 NS 0.24 SS 0.20 SS
	1955	-1.15 SS	0.00 NS	1948-55 0.27 S -0.72 SS 0.26 SS
9-11	1948	0.11 NS	-2.19 SS	1948-51 0.28 SS -0.74 SS 0.55 SS
	1951	-0.91 SS	-0.90 SS	1951-53 0.13 S -0.26 S } -0.31 SS
	1953	-1.30 SS	...	1953-54 -0.18 S -0.24 S
	1954	-1.36 SS	-0.71 SS	1954-55 -0.03 NS 0.02 NS 0.39 SS
	1955	-1.31 SS	-0.34 SS	1948-55 0.20 S -1.22 SS 0.63 SS
12-14	1948	0.03 NS	-1.89 SS	1948-51 0.01 NS -0.23 SS 0.23 S
	1951	-0.21 SS	-1.43 SS	1951-53 0.13 S -0.27 SS } -0.11 NS
	1953	-0.61 SS	...	1953-54 -0.10 NS -0.11 NS
	1954	-0.62 SS	-1.16 SS	1954-55 0.03 NS 0.00 NS 0.33 SS
	1955	-0.65 SS	-0.83 SS	1948-55 0.07 NS -0.61 SS 0.45 SS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE VII

PERCENTAGE OF CHILDREN HAVING CARIES-FREE PERMANENT UPPER INCISORS

		Percentage of Children Having Caries-Free Permanent Upper Incisors and Standard Error of Percentage					
Age Group	Year	Sarnia	Brantford	Stratford			
9-11	1948	76.53 $\pm$ 1.774	82.86 $\pm$ 1.544	97.07 $\pm$ 0.807			
	1951	80.94 $\pm$ 1.580	94.46 $\pm$ 0.948	96.93 $\pm$ 0.812			
	1953	74.33 $\pm$ 1.683	96.17 $\pm$ 0.817	... ..			
	1954	71.90 $\pm$ 1.867	92.23 $\pm$ 1.195	95.47 $\pm$ 0.943*			
	1955	70.68 $\pm$ 1.902	91.57 $\pm$ 1.216	95.05 $\pm$ 0.985**			
12-14	1948	53.91 $\pm$ 2.261	56.16 $\pm$ 2.037	95.69 $\pm$ 1.053			
	1951	53.36 $\pm$ 2.217	69.40 $\pm$ 1.905	90.38 $\pm$ 1.482			
	1953	40.82 $\pm$ 2.117	77.03 $\pm$ 1.849	... ..			
	1954	39.67 $\pm$ 2.092	74.08 $\pm$ 1.979	84.60 $\pm$ 1.845*			
	1955	44.54 $\pm$ 2.257	78.20 $\pm$ 1.806	79.72 $\pm$ 1.930**			
	Differences in Percentage of Children Having Caries-Free Permanent Upper Incisors						
	Inter-City			Inter-Year			
Age Group	Year	Sarnia-Brantford	Brantford-Stratford	Years	Sarnia	Brantford	Stratford
9-11	1948	6.33 S	14.21 SS	1948-51	4.41 NS	11.60 SS	-0.14 NS
	1951	13.52 SS	2.47 NS	1951-53	-6.61 S	1.71 NS	} -1.46 NS
	1953	21.84 SS	...	1953-54	-2.43 NS	-3.94 S	
	1954	20.33 SS	3.24 S	1954-55	-1.22 NS	-0.66 NS	-0.42 NS
	1955	20.89 SS	3.48 S	1948-55	-5.85 S	8.71 SS	-2.02 NS
12-14	1948	2.25 NS	39.53 SS	1948-51	-0.55 NS	13.24 SS	-5.31 S
	1951	16.04 SS	20.98 SS	1951-53	-12.54 SS	7.63 S	} -5.78 S
	1953	36.21 SS	...	1953-54	-1.15 NS	-2.95 NS	
	1954	34.41 SS	10.52 SS	1954-55	4.87 NS	4.12 NS	-4.88 NS
	1955	33.66 SS	1.52 NS	1948-55	-9.37 S	22.04 SS	-15.97 SS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE VIII

MEAN DMF (DECAYED, MISSING, FILLED) PERMANENT UPPER INCISORS PER CHILD

Age Group	Year	Mean DMF Permanent Upper Incisors Per Child and Standard Error of Mean		
		Sarnia	Brantford	Stratford
9-11	1948	0.56 $\pm$ 0.048	0.34 $\pm$ 0.034	0.01 $\pm$ 0.007
	1951	0.43 $\pm$ 0.041	0.11 $\pm$ 0.021	0.04 $\pm$ 0.011
	1953	0.56 $\pm$ 0.043	0.05 $\pm$ 0.013	... ..
	1954	0.60 $\pm$ 0.046	0.11 $\pm$ 0.018	0.07 $\pm$ 0.017*
	1955	0.65 $\pm$ 0.049	0.13 $\pm$ 0.021	0.07 $\pm$ 0.015**
12-14	1948	1.16 $\pm$ 0.066	1.05 $\pm$ 0.058	0.07 $\pm$ 0.020
	1951	1.16 $\pm$ 0.065	0.64 $\pm$ 0.046	0.15 $\pm$ 0.025
	1953	1.56 $\pm$ 0.067	0.53 $\pm$ 0.048	... ..
	1954	1.52 $\pm$ 0.065	0.50 $\pm$ 0.044	0.25 $\pm$ 0.034*
	1955	1.28 $\pm$ 0.065	0.41 $\pm$ 0.040	0.36 $\pm$ 0.039**
Differences in Mean DMF Permanent Upper Incisors Per Child				
Age Group	Inter-City			Inter-Year
	Year	Sarnia-Brantford	Brantford-Stratford	Years Sarnia Brantford Stratford
9-11	1948	-0.22 SS	-0.33 SS	1948-51 -0.13 S -0.23 SS 0.03 SS
	1951	-0.32 SS	-0.07 SS	1951-53 0.13 S -0.06 S) 0.03 NS
	1953	-0.51 SS	...	1953-54 0.04 NS 0.06 S) 0.00 NS
	1954	-0.49 SS	-0.04 NS	1954-55 0.05 NS 0.02 NS) 0.06 SS
	1955	-0.52 SS	-0.06 S	1948-55 0.09 NS -0.21 SS
12-14	1948	-0.11 NS	-0.98 SS	1948-51 0.00 NS -0.41 SS 0.08 NS
	1951	-0.52 SS	-0.49 SS	1951-53 0.40 SS -0.11 NS) 0.10 S
	1953	-1.03 SS	...	1953-54 -0.04 NS -0.03 NS) 0.11 S
	1954	-1.02 SS	-0.25 SS	1954-55 -0.24 S -0.09 NS) 0.29 SS
	1955	-0.87 SS	-0.05 NS	1948-55 0.12 NS -0.64 SS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE IX

PERCENTAGE OF CHILDREN HAVING CARIES-FREE DECIDUOUS TEETH

Age Group	Year	Percentage of Children Having Caries-Free Deciduous Teeth and Standard Error of Percentage					
		Sarnia	Brantford	Stratford			
16-8	1948	10.16 $\pm$ 1.170	12.28 $\pm$ 1.320	35.65 $\pm$ 2.131			
	1951	10.13 $\pm$ 1.146	22.80 $\pm$ 1.743	30.38 $\pm$ 2.063			
	1953	9.42 $\pm$ 1.027	21.67 $\pm$ 1.797	... ..			
	1954	8.32 $\pm$ 1.174	29.18 $\pm$ 2.054	31.42 $\pm$ 1.804*			
	1955	8.58 $\pm$ 1.172	23.82 $\pm$ 1.890	30.87 $\pm$ 1.986**			
9-11	1948	33.63 $\pm$ 1.977	34.96 $\pm$ 1.956	40.97 $\pm$ 2.366			
	1951	32.47 $\pm$ 1.883	33.56 $\pm$ 1.965	41.23 $\pm$ 2.305			
	1953	37.39 $\pm$ 1.864	40.33 $\pm$ 2.095	... ..			
	1954	37.93 $\pm$ 2.015	38.65 $\pm$ 2.173	41.98 $\pm$ 2.239*			
	1955	36.13 $\pm$ 2.007	37.93 $\pm$ 2.124	42.27 $\pm$ 2.243**			
Differences in Percentage of Children Having Caries-Free Deciduous Teeth							
Age Group	Inter-City			Inter-Year			
	Year	Sarnia-Brantford	Brantford-Stratford	Years	Sarnia	Brantford	Stratford
6-8	1948	2.12 NS	23.36 SS	1948-51	-0.03 NS	10.52 SS	-5.26 NS
	1951	12.67 SS	7.58 S	1951-53	-0.71 NS	-1.13 NS	} 1.04 NS
	1953	12.25 SS	...	1953-54	-1.10 NS	7.51 S	
	1954	20.86 SS	2.24 NS	1954-55	0.26 NS	-5.36 NS	-0.55 NS
	1955	15.24 SS	7.05 S	1948-55	-1.58 NS	11.54 SS	-4.77 NS
9-11	1948	1.33 NS	6.01 S	1948-51	-1.16 NS	-0.40 NS	0.26 NS
	1951	1.09 NS	7.67 S	1951-53	4.92 NS	6.77 S	} 0.75 NS
	1953	2.94 NS	...	1953-54	0.54 NS	-1.68 NS	
	1954	0.72 NS	3.33 NS	1954-55	-1.80 NS	-0.72 NS	0.29 NS
	1955	1.80 NS	4.34 NS	1948-55	2.50 NS	2.97 NS	1.30 NS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

TABLE X

MEAN df (decayed, filled) DECIDUOUS TEETH PER CHILD

Age Group	Year	Mean df Deciduous Teeth Per Child and Standard Error of Mean					
		Sarnia		Brantford		Stratford	
6-8	1948	4.89 $\pm$ 0.122	4.95 $\pm$ 0.134	2.20 $\pm$ 0.107			
	1951	4.89 $\pm$ 0.119	3.58 $\pm$ 0.126	2.62 $\pm$ 0.115			
	1953	5.17 $\pm$ 0.113	3.22 $\pm$ 0.125	...	...		
	1954	5.21 $\pm$ 0.132	2.76 $\pm$ 0.120	2.63 $\pm$ 0.110*			
	1955	5.09 $\pm$ 0.130	2.93 $\pm$ 0.121	2.60 $\pm$ 0.113**			
9-11	1948	2.50 $\pm$ 0.111	2.37 $\pm$ 0.101	1.66 $\pm$ 0.095			
	1951	2.41 $\pm$ 0.101	2.25 $\pm$ 0.098	1.76 $\pm$ 0.094			
	1953	2.26 $\pm$ 0.094	1.94 $\pm$ 0.097	...	...		
	1954	2.11 $\pm$ 0.098	1.93 $\pm$ 0.095	1.58 $\pm$ 0.089*			
	1955	2.31 $\pm$ 0.102	1.99 $\pm$ 0.094	1.65 $\pm$ 0.094**			
Age Group	Differences in Mean df Deciduous Teeth Per Child						
	Year	Inter-City		Inter-Year			
		Sarnia- Brantford	Brantford- Stratford	Years	Sarnia	Brantford	Stratford
6-8	1948	0.06 NS	-2.75 SS	1948-51	0.00 NS	-1.37 SS	0.42 S
	1951	-1.31 SS	-0.96 SS	1951-53	0.28 NS	-0.36 S	} 0.01 NS
	1953	-1.95 SS	...	1953-54	0.04 NS	-0.46 S	
	1954	-2.45 SS	-0.13 NS	1954-55	-0.12 NS	0.17 NS	-0.03 NS
	1955	-2.16 SS	-0.33 NS	1948-55	0.20 NS	-2.02 SS	0.40 S
9-11	1948	-0.13 NS	-0.71 SS	1948-51	-0.09 NS	-0.12 NS	0.10 NS
	1951	-0.16 NS	-0.49 SS	1951-53	-0.15 NS	-0.31 S	} -0.18 NS
	1953	-0.32 S	...	1953-54	-0.15 NS	-0.01 NS	
	1954	-0.18 NS	-0.35 S	1954-55	0.20 NS	0.06 NS	0.07 NS
	1955	-0.32 S	-0.34 S	1948-55	-0.19 NS	-0.38 S	-0.01 NS

For footnotes, levels of statistical significance, and discussion of standard error, see page 35.

Footnotes:

Decrease indicated by minus sign.

- * November 1953; considered as "1954" for comparison purposes.
- ** November 1954; considered as "1955" for comparison purposes.

Levels of statistical significance:

- S Statistically significant at two standard error level;
- SS Statistically significant at three standard error level;
- NS Not statistically significant (p greater than 5%).

Standard error:

The standard error is a measure of the variation which is associated with the sampling process. The difference between two index values is said to be statistically significant when the probability of it arising from chance or sampling variation, i.e., rather than from one specific factor such as fluoridation, is below some agreed value. The agreed levels of statistical significance are arbitrary but are generally assumed to be the two standard error and three standard error levels. The probability of obtaining, by chance, a difference of the magnitude of two standard errors between two observed values is about 0.0445 or just below 5 per cent. The odds against such a difference occurring are, therefore, about 21 to 1. For the three standard error level, the probability is less than one per cent (0.27 per cent) and the odds are 369 to 1 against this occurrence by chance. When differences of these magnitudes are found, particularly those as great as three standard errors, we may feel quite confident in discussing them in terms of our hypothesis.

Standard errors shown have not been adjusted for finite population correction and are therefore overstated. Where no sampling was done in Sarnia and Stratford, the sampling error is, of course, zero; but the standard errors shown are used in the comparison of pairs of averages.

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